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DINOSAURS!

•DISCOVER THE GIANTS OF THE P ORIC WORLD•

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DINOSAURS! is published by
Orbis Publishing Ltd
Griffin House
161 Hammersmith Rd
London W6 8SD
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N29 93 10 21

Printed in Italy by Officine Grafiche De Agostini, Novara

SPINOSAURUS

Huge *Spinosaurus* had a fan-shaped row of spines along its back which supported an upright sail of skin.

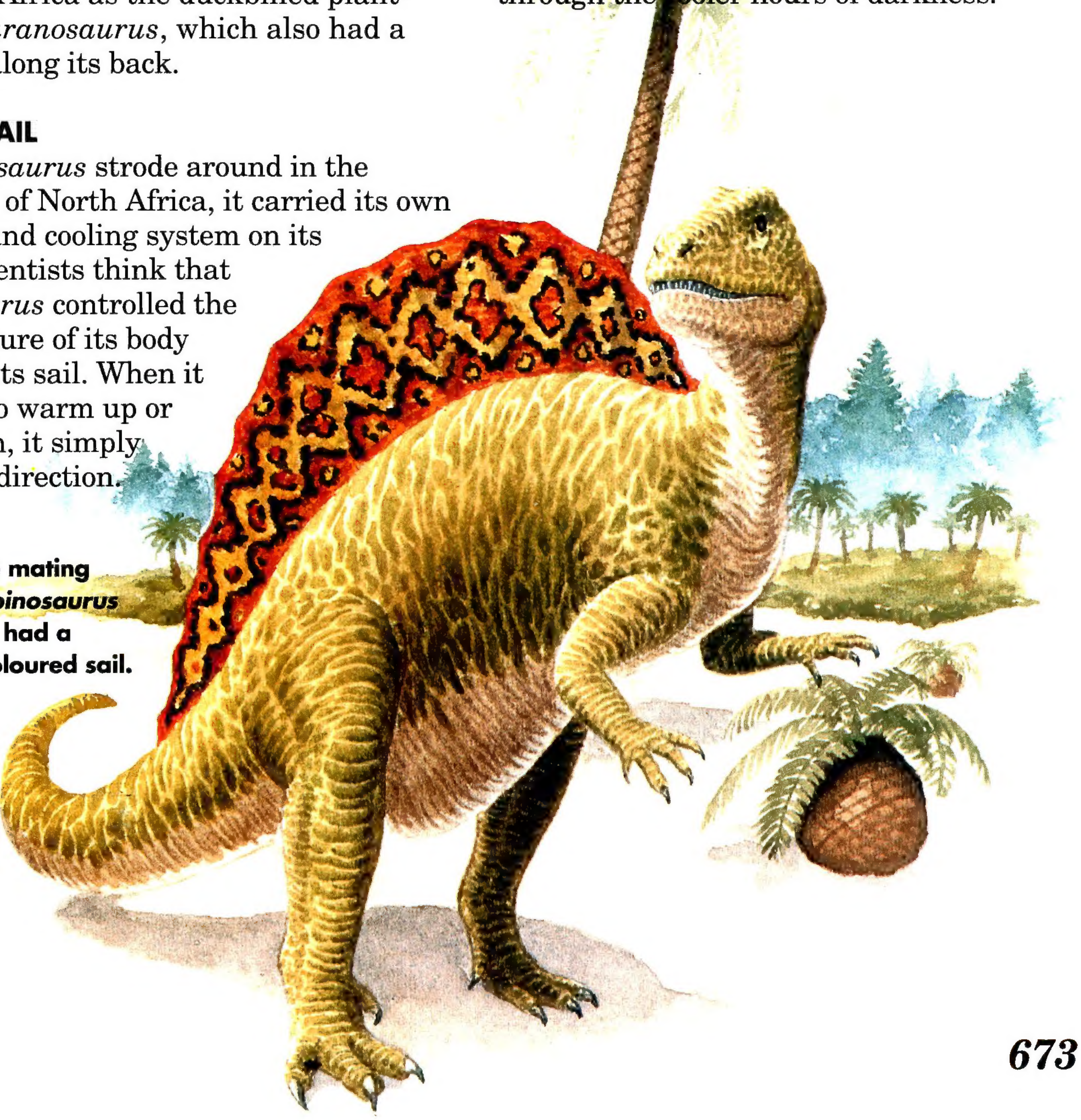
Spinosaurus was a meat-eating dinosaur as long as two elephants and as heavy as three cars. It was found in the same part of North Africa as the duckbilled plant-eater, *Ouranosaurus*, which also had a tall sail along its back.

SOLAR SAIL

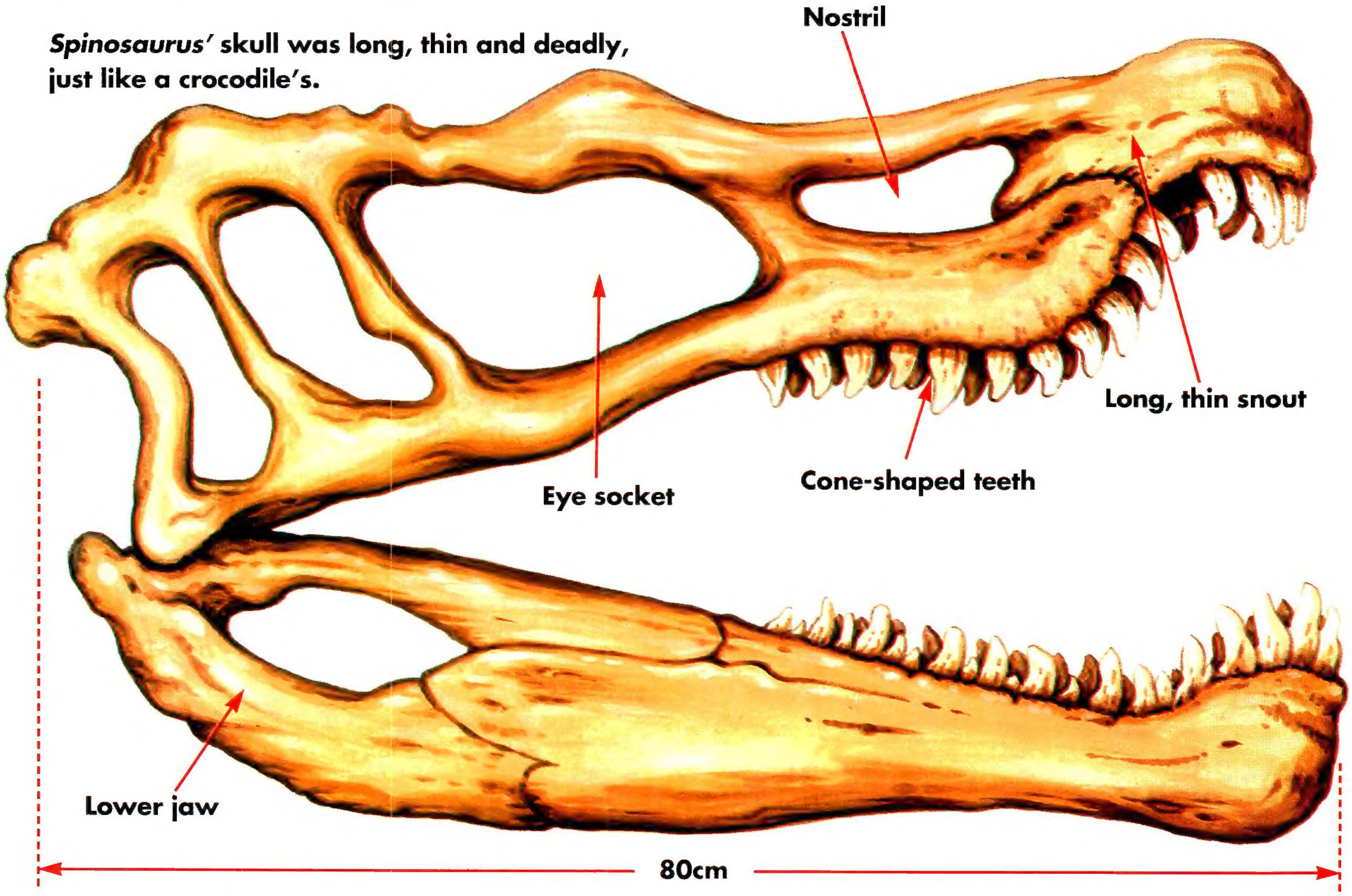
As *Spinosaurus* strode around in the sunshine of North Africa, it carried its own heating and cooling system on its back. Scientists think that *Spinosaurus* controlled the temperature of its body through its sail. When it wanted to warm up or cool down, it simply changed direction.

SUN TRAP

By standing sideways to the sun, *Spinosaurus* soaked up the heat through its enormous sail of skin. Parts of the sail were as tall as a human and the big surface worked like a sun trap. The warmth of the sun's rays spread through the rest of the dinosaur's large body. The stored heat kept *Spinosaurus* warm right through the cooler hours of darkness.



During the mating season, *Spinosaurus* may have had a brightly coloured sail.



***Spinosaurus'* skull was long, thin and deadly, just like a crocodile's.**

HEAT EXCHANGE

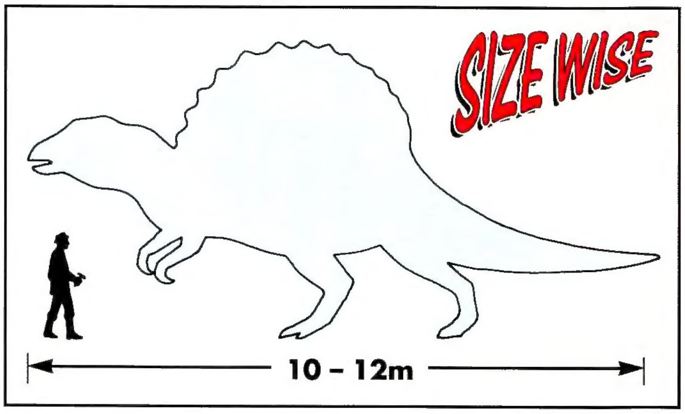
When you get too hot, you probably look for shade and have a cool drink. *Spinosaurus* had its own way of cooling down. When there was a breeze it stood with its sail sideways on to the wind, which helped to lower its body temperature. As it cooled the sail sent out heat like a giant radiator. So *Spinosaurus* did not become overheated, even on the hottest day.

CROCODILE JAW

Like many other carnivorous dinosaurs, *Spinosaurus* had powerful jaws and a fearsome set of teeth. Its jaws were long like a crocodile's and filled with sharp, straight teeth. *Spinosaurus* could open its jaws wide and snap them shut to trap the flesh of its unlucky victim. Some scientists believe that *Spinosaurus* may have eaten fish as well as meat.

MONSTER FACTS

- **NAME:** *Spinosaurus* (spine-o-saw-rus) means 'thorn reptile'
- **SIZE:** about 10 – 12m long
- **FOOD:** meat and possibly fish
- **LIVED:** about 110 million years ago in the Cretaceous in Egypt and Niger, northern Africa



LONG BUT LIGHT

Spinosaurus walked on two legs, leaving its front limbs free to grasp its prey. As it ran, it held out its long, tapering tail for balance. *Spinosaurus* was quite a lightweight dinosaur in spite of its immense size. It was probably able to move quickly, in short bursts of speed.

SAIL SIGNALS

Some scientists think that *Spinosaurus*' sail may have been brightly coloured. It may have used it as a warning signal to threaten other males. *Spinosaurus* may also have displayed its sail to attract a mate during the breeding season. Whatever its use, the tall sail made an impressive sight as *Spinosaurus* strutted across the Cretaceous landscape.

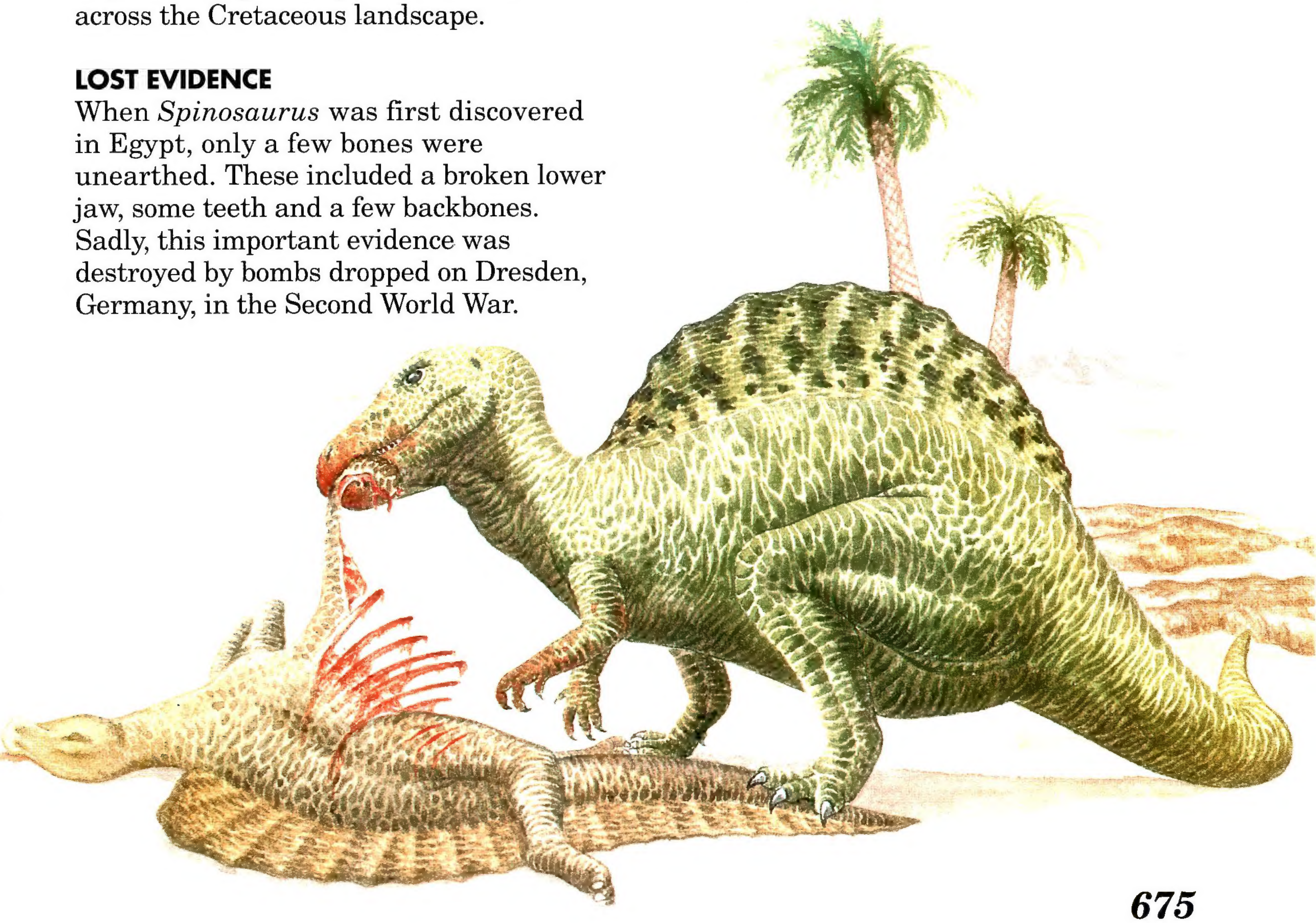
LOST EVIDENCE

When *Spinosaurus* was first discovered in Egypt, only a few bones were unearthed. These included a broken lower jaw, some teeth and a few backbones. Sadly, this important evidence was destroyed by bombs dropped on Dresden, Germany, in the Second World War.

What is? A SPINOSAURID

Spinosaurids are an unusual family of theropod dinosaurs with tall spines along their backs which supported a sail of skin. The family was founded on *Spinosaurus* and includes sail-backed dinosaurs *Altispinax* and *Metriacanthosaurus*. *Acrocanthosaurus*, from Oklahoma, USA, was 13m long. That's even bigger than *Spinosaurus*.

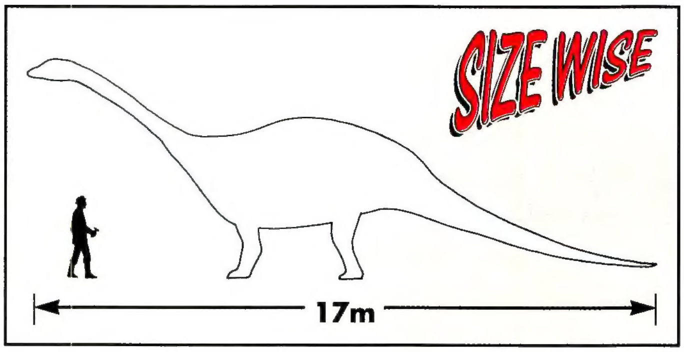
***Spinosaurus* (below right) and *Ouranosaurus* (below left) were both sail-backed dinosaurs. They may have met each other on the plains of Cretaceous Africa. If they fought, *Spinosaurus*, with its sharp claws and terrifying teeth, would definitely have won.**



RHOETOSAURUS

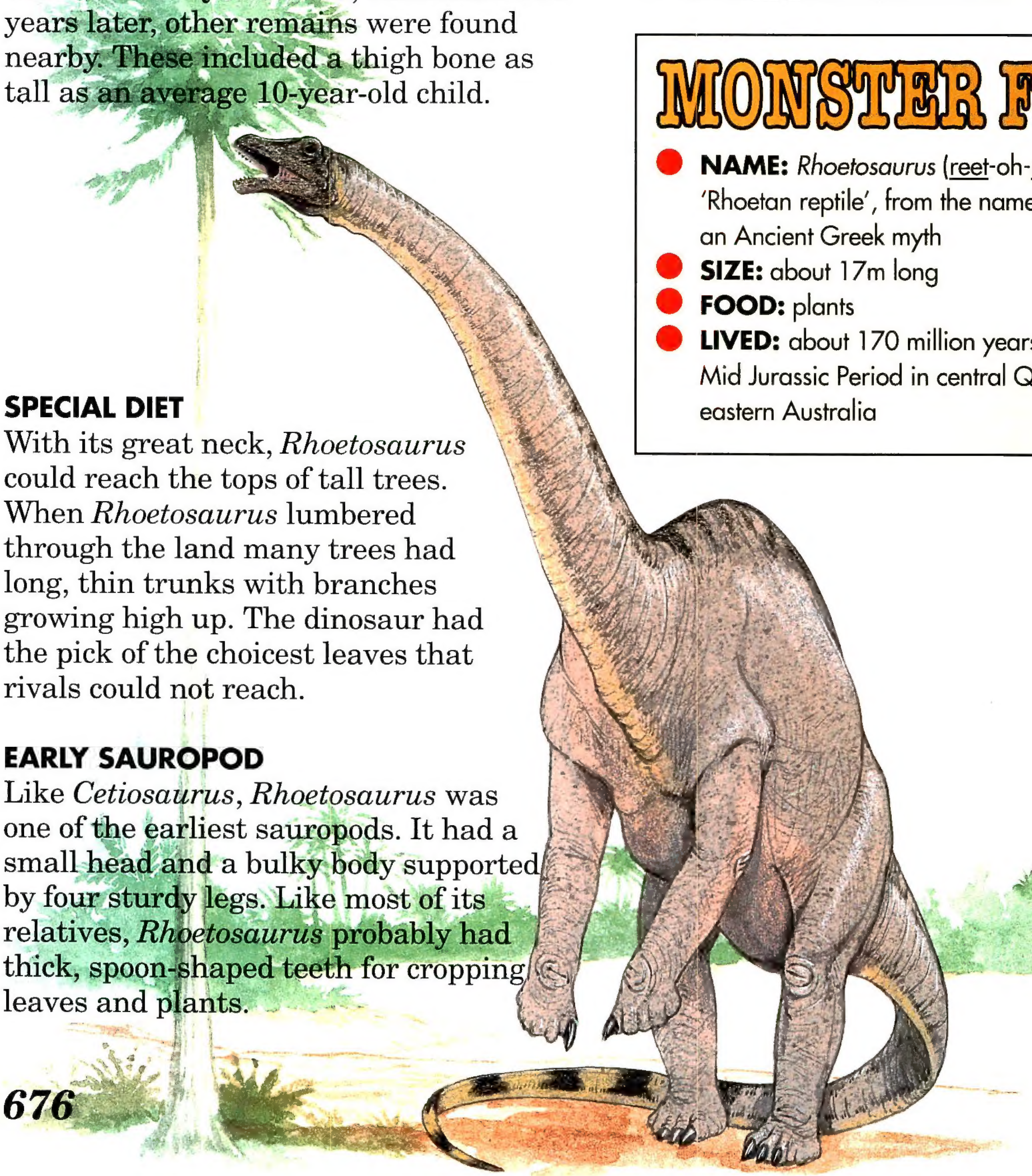
***Rhoetosaurus* was an enormous dinosaur, about three times taller than a human and longer than a lorry.**

The skeleton of long-necked *Rhoetosaurus* was discovered in two parts. In 1924, its tail was found in Queensland, Australia. Two years later, other remains were found nearby. These included a thigh bone as tall as an average 10-year-old child.



MONSTER FACTS

- **NAME:** *Rhoetosaurus* (reet-oh-saw-rus) means 'Rhoetan reptile', from the name of a giant in an Ancient Greek myth
- **SIZE:** about 17m long
- **FOOD:** plants
- **LIVED:** about 170 million years ago in the Mid Jurassic Period in central Queensland, eastern Australia



SPECIAL DIET

With its great neck, *Rhoetosaurus* could reach the tops of tall trees. When *Rhoetosaurus* lumbered through the land many trees had long, thin trunks with branches growing high up. The dinosaur had the pick of the choicest leaves that rivals could not reach.

EARLY SAUROPOD

Like *Cetiosaurus*, *Rhoetosaurus* was one of the earliest sauropods. It had a small head and a bulky body supported by four sturdy legs. Like most of its relatives, *Rhoetosaurus* probably had thick, spoon-shaped teeth for cropping leaves and plants.

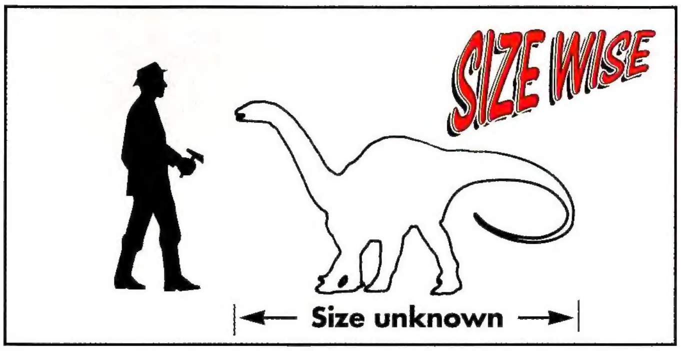
MUSSAURUS

Scientists are not sure what an adult *Mussaurus* looked like, as only babies have been discovered so far.

One of the tiniest of all known dinosaurs, *Mussaurus* was named from the discovery of several incomplete skeletons found together in a nest. They were small enough to fit easily into the palm of an adult human's hand. Nearby were the remains of two eggs about the size of small pebbles. The little dinosaurs had died before they were old enough to leave the nest.

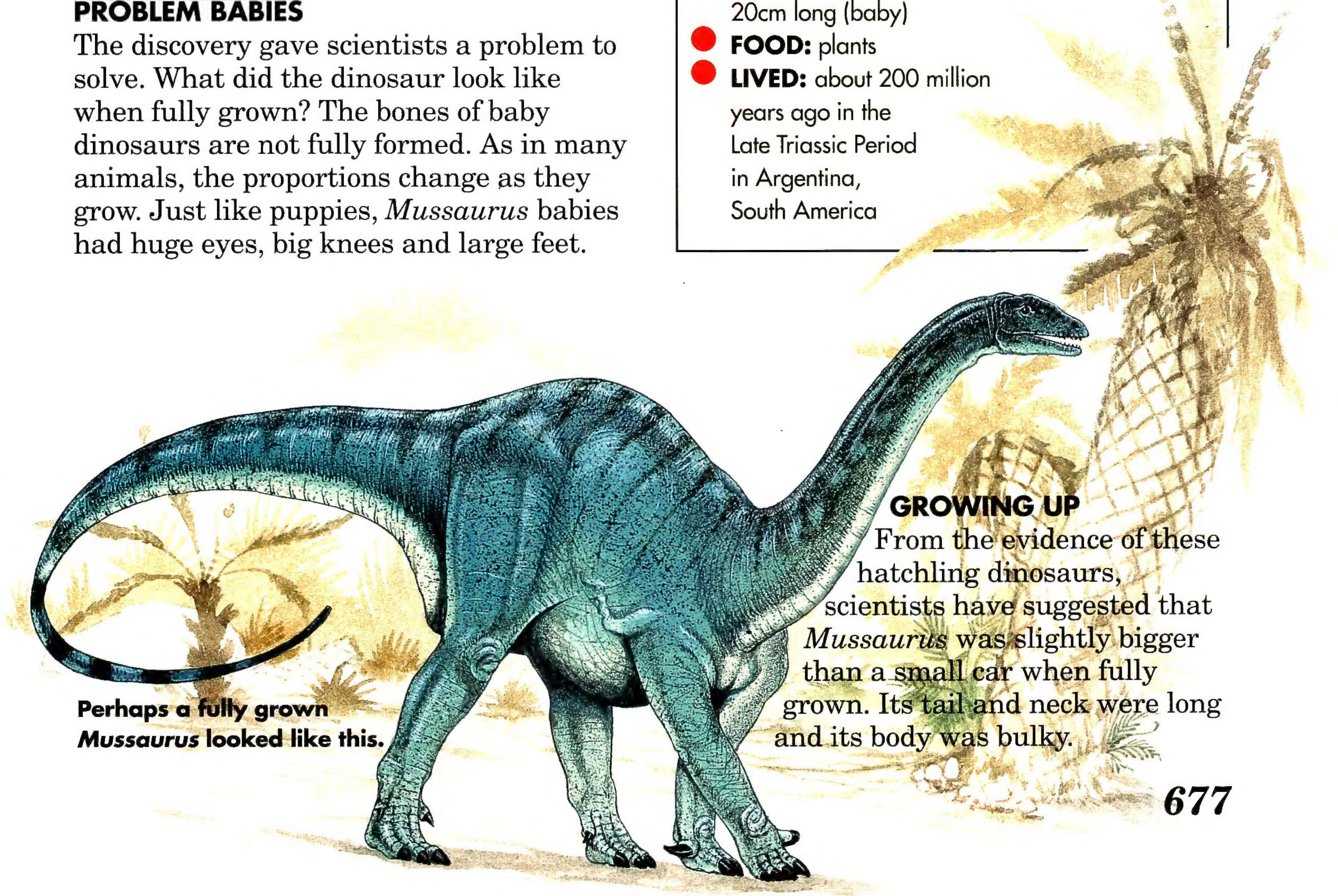
PROBLEM BABIES

The discovery gave scientists a problem to solve. What did the dinosaur look like when fully grown? The bones of baby dinosaurs are not fully formed. As in many animals, the proportions change as they grow. Just like puppies, *Mussaurus* babies had huge eyes, big knees and large feet.



MONSTER FACTS

- **NAME:** *Mussaurus* (muss-aw-rus) means 'mouse reptile'
- **SIZE:** unknown (adult), 20cm long (baby)
- **FOOD:** plants
- **LIVED:** about 200 million years ago in the Late Triassic Period in Argentina, South America



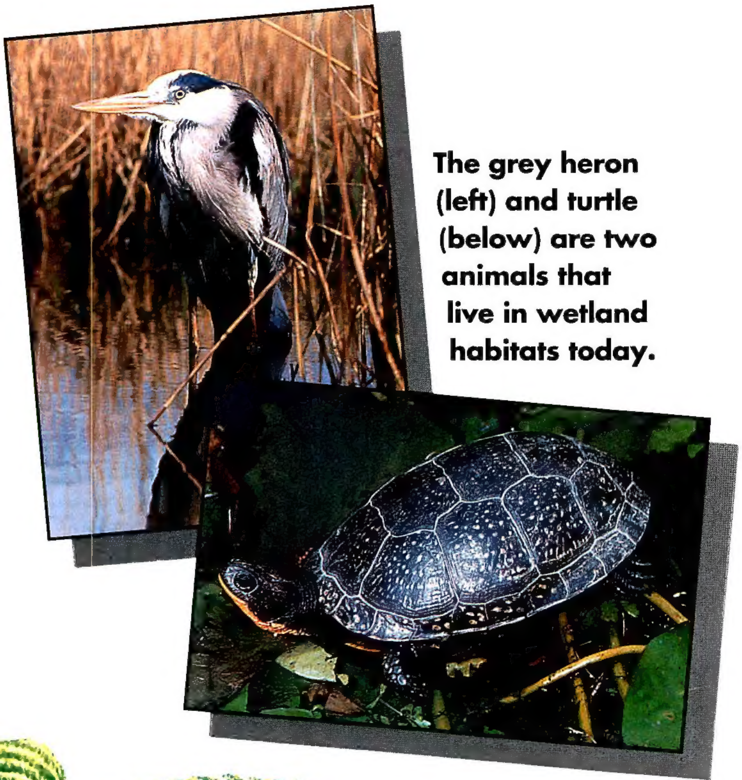
Perhaps a fully grown *Mussaurus* looked like this.

GROWING UP

From the evidence of these hatchling dinosaurs, scientists have suggested that *Mussaurus* was slightly bigger than a small car when fully grown. Its tail and neck were long and its body was bulky.

Marsh monsters

Swamps and marshes today are full of animal life – just as they were in the Age of the Dinosaurs.



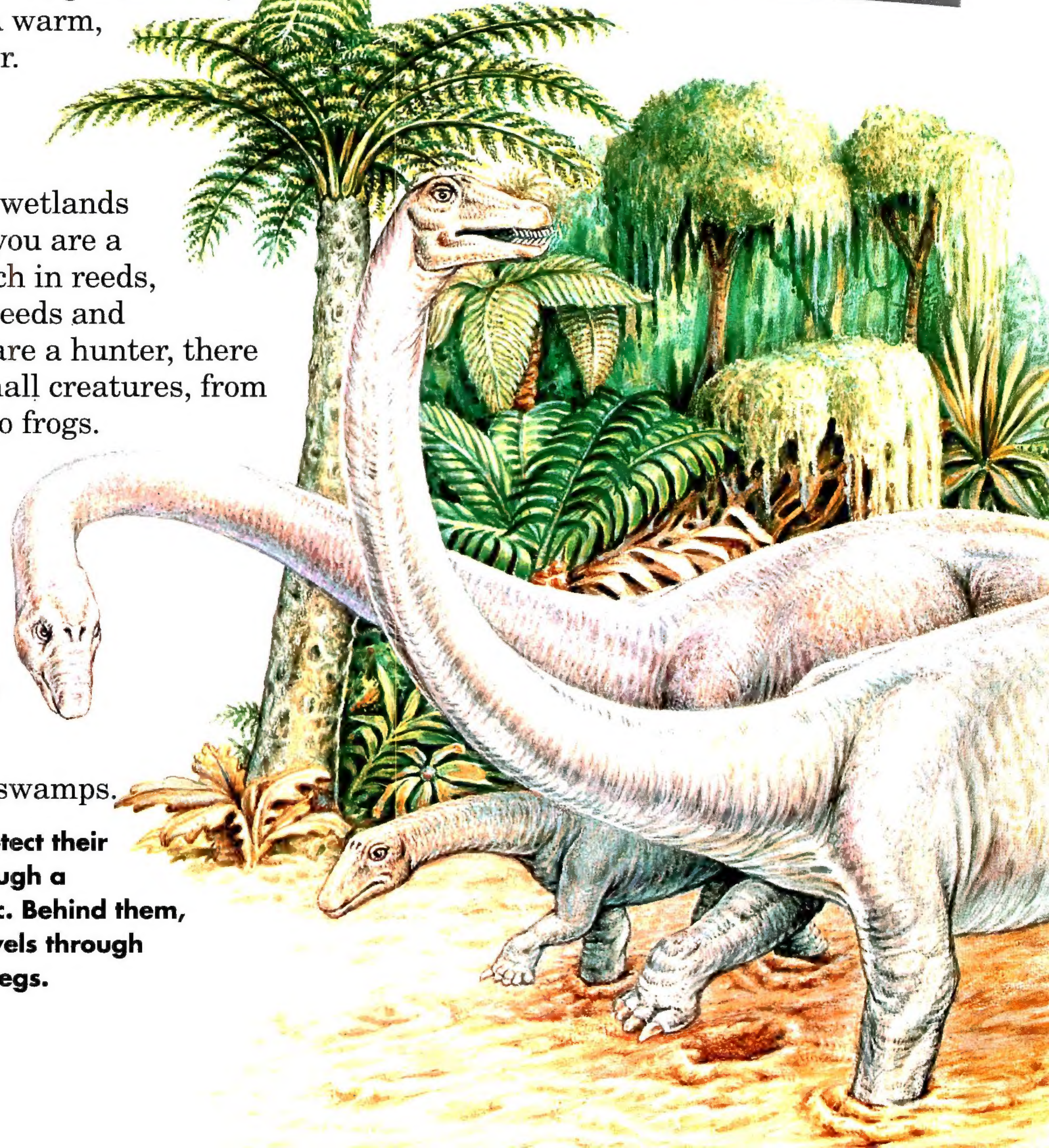
The grey heron (left) and turtle (below) are two animals that live in wetland habitats today.

For humans, wetlands such as marshes, swamps, bogs, river banks and lake shores are uncomfortable. We sink into the mud. We get damp and cold. And we get bitten by the irritating insects. A warm, dry place is much better.

LOTS OF FOOD – AND WATER

But for many animals, wetlands are fabulous places. If you are a plant-eater, they are rich in reeds, rushes, sedges, waterweeds and other plant life. If you are a hunter, there are vast numbers of small creatures, from insects to worms, fish to frogs. And there's plenty of water to drink!

Reptiles especially like wetlands. Their scaly skin keeps out the mud, damp and insect pests. Today crocodiles, alligators, snakes, lizards and turtles all thrive in marshes and swamps.



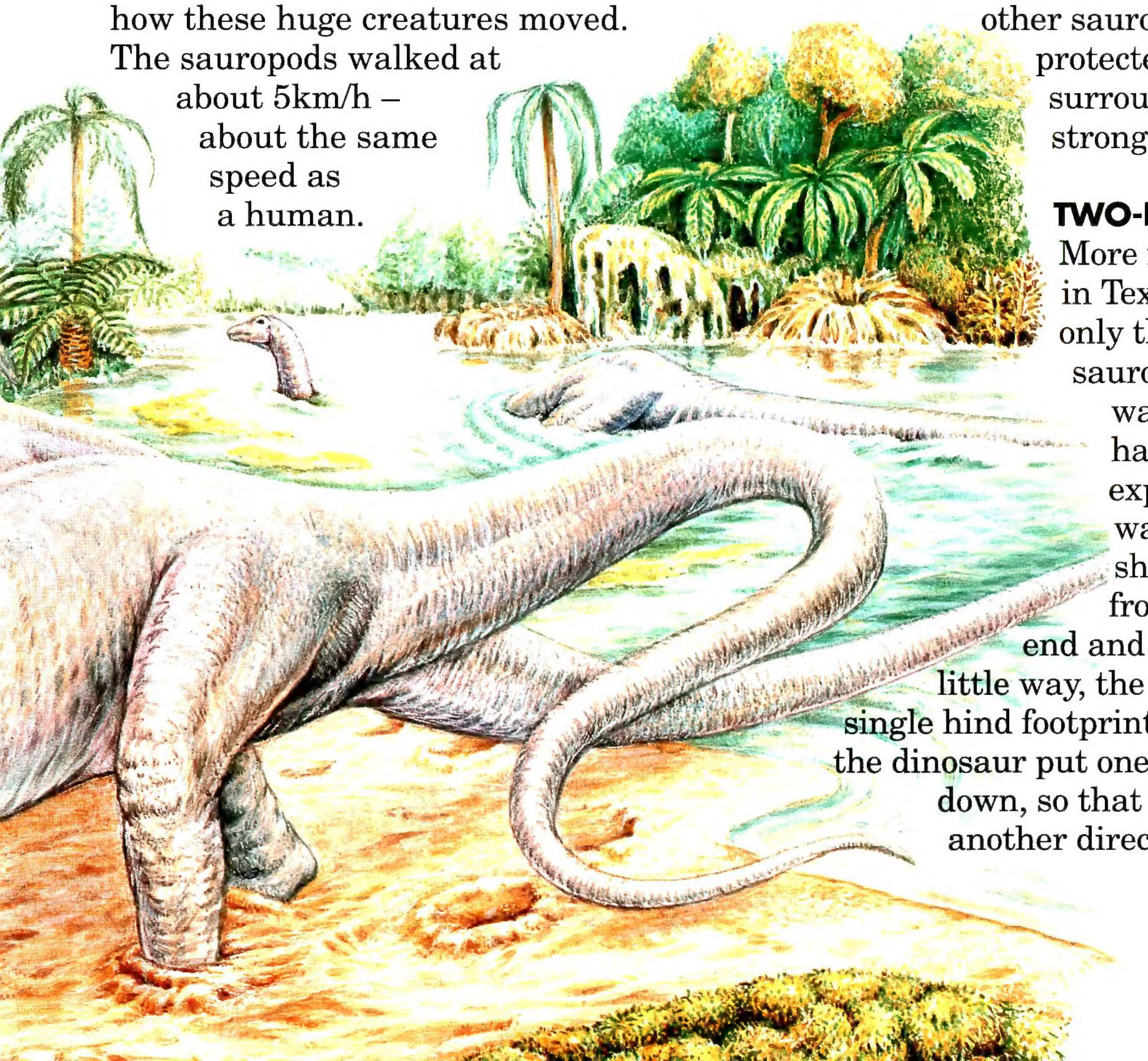
Two *Diplodocus* (right) protect their baby as they squelch through a swamp in the Late Jurassic. Behind them, another herd member travels through deeper water on its front legs.

STEAMY PREHISTORIC SWAMPS

Many dinosaurs lived in swamps, rivers and other wetlands. We know this because preserved with their bones are the fossils of wetland plants and fish. At the start of the Age of the Dinosaurs, the world was warm and dry. There were few wetlands. But during the Jurassic, more rain fell. Marshes, swamps and great winding rivers appeared. It was a damp, tropical paradise for some of the most famous dinosaurs.

GOOD PLACES FOR FOOTPRINTS

About 150 million years ago, a huge sauropod left a neat track of footprints in sandflats in what is now Texas. Each print measured 1m across – the width of a big bass drum. The prints dried hard, were covered in mud, and gradually became fossils. Scientists measured the size and depth of the prints and the distances between them. This information shows how these huge creatures moved. The sauropods walked at about 5km/h – about the same speed as a human.



Is it true that fresh air can help to form fossils?

Yes. Dinosaurs and other creatures walked in soft mud or sand, and left footprints filled with fresh air. The prints baked dry in the air. Later, they filled with fine mud, which was buried and slowly turned into hard rock. The prints were preserved. Dinosaur footprints have been found all over the world. They tell us how dinosaurs moved, what groups they lived in, and how they hunted.

A FAMILY WALK

At several fossil sites, there are sauropod tracks parallel to each other in soft marshy ground. They were probably left by herds of animals on the move. They show that these dinosaurs travelled in groups. Often, the largest footprints are on the outside, with smaller ones in the middle. Perhaps young *Diplodocus,* or other sauropods, walked well protected in the centre, surrounded by the huge, strong adults.

TWO-LEGGED WADING?

More fossil prints, found in Texas, seem to show only the front feet of a sauropod. This dinosaur was far too big to do handstands! One explanation is that it was walking across a shallow lake on its front legs, with its rear end and tail floating. After a little way, the tracks turn, and a single hind footprint appears. Perhaps the dinosaur put one of its back legs down, so that it could push off in another direction.

Frilled plant-eater *Anchiceratops* (below) is set upon by a pack of agile, vicious *Dromaeosaurus* by a marshy riverside in the Late Cretaceous.

GETTING WETTER

During the Cretaceous Period, the sea level rose and separated the shifting continents. Great flood plains crossed Europe. Much of North America turned to swampy jungle. These were good places to live, with plenty of food and water. They are rich places for dinosaur fossils today.

FLOOD PLAIN HOME

Iguanodon fossils have been found in Europe, Asia and Africa. This dinosaur ate plants, like ferns and horsetails, that grow in moist places. In 1878, 39 skeletons were found in a coal mine in Belgium. We know the dinosaurs died in a watery place because fish, crocodiles and turtles were buried with them. *Iguanodon* must have drunk there over many years, because their bodies date from different times.

IT'S A FACT

THAT SWAMPS CHANGE ALL THE TIME

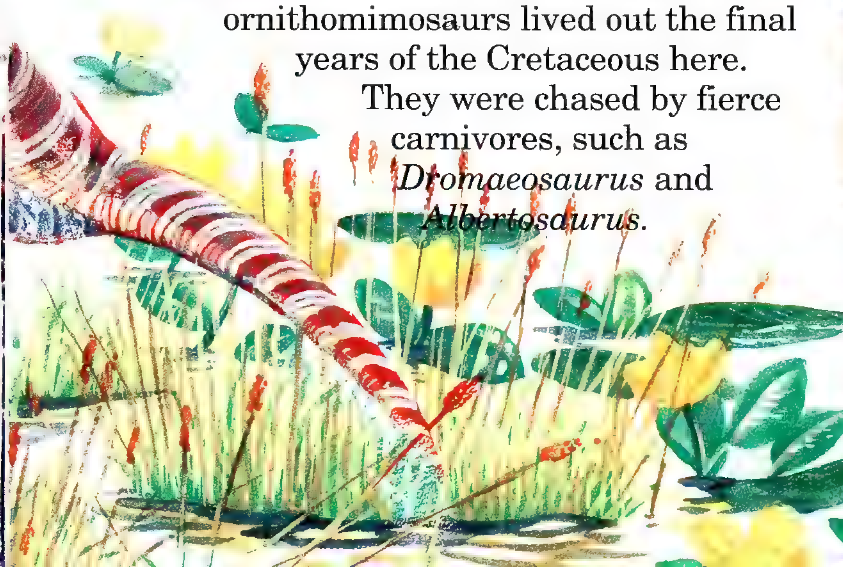
Swamps and marshes today are not permanent, unchanging places. They change very slowly all the time. The plants vary depending on the water level of the marsh. Sometimes a swamp dries up if the river that feeds it runs low during the dry season. Plants can dry out a marsh, too. They start by growing round the edges. Gradually dead leaves and silt build up around the bottom of the plants, which slowly spread out into wetter areas. Changes like these took place throughout the Age of the Dinosaurs.

ONCE THEY WERE SWAMPS

About 75 million years ago, the Badlands of North America were covered with steamy, tropical swamps. The area is so rich in dinosaur fossils that it has become a United Nations world heritage site, like the pyramids in Egypt.

END OF AN ERA

Hadrosaurs, ceratopians, ankylosaurs and ornithomimosaurs lived out the final years of the Cretaceous here. They were chased by fierce carnivores, such as *Dromaeosaurus* and *Albertosaurus*.



FOSSILS IN COAL

One of these dinosaurs was *Anchiceratops*, a ceratopian with a very long neck frill. Its fossils were found in coal, which is the fossilized remains of plants from swampy forests. *Anchiceratops* probably chomped the ferns and cycads with its sharp beak.

FINELY FORMED FOSSILS

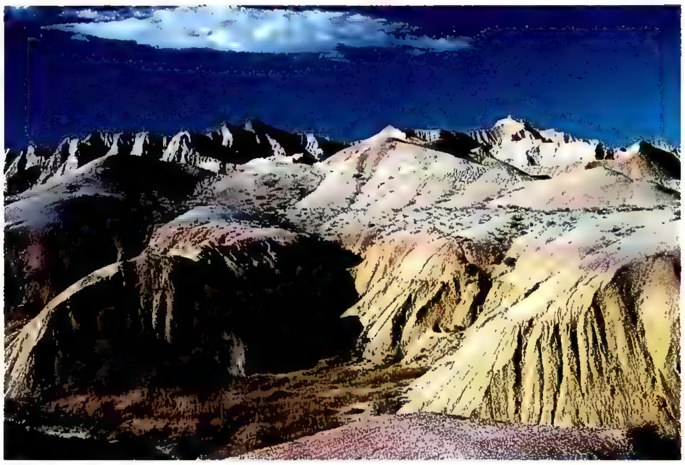
During the Jurassic Period, central Europe was mainly islands and lagoons. Many fossils have been found, preserved in minute detail in the very fine mud and sand. This settled over the animals' bodies after they fell into the shallow water.

SEASIDE SPEEDSTERS

One of these animals was *Compsognathus*, a tiny dinosaur which raced along the water's edge, catching small animals. Another was *Struthiomimus*, with its long neck and legs and widely splayed toes.

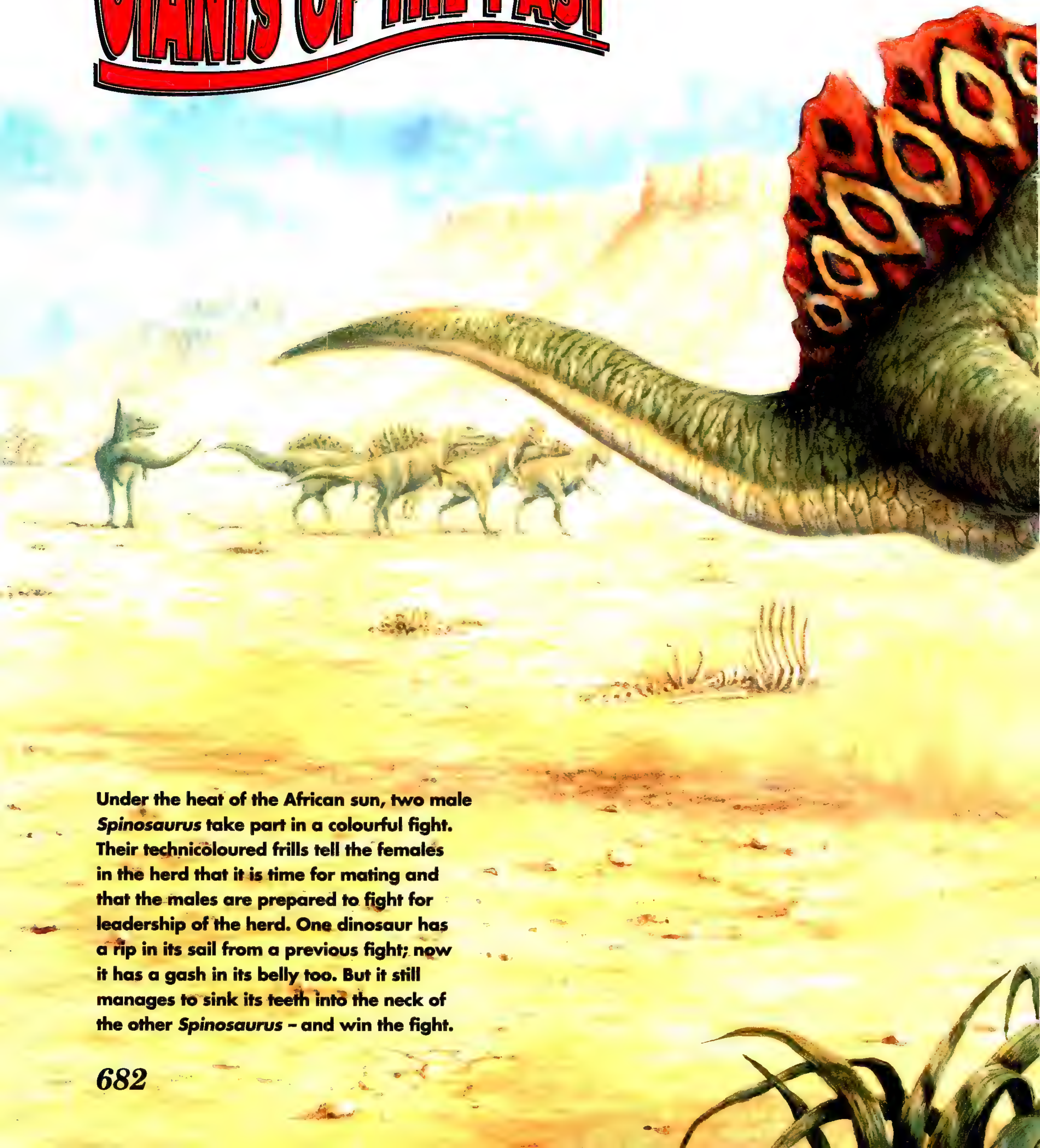
AT HOME IN THE WET

Whether they hunted among sand dunes by the sea, or squelched through the lush, steamy depths of inland marshes, many dinosaurs were well equipped to survive in wet places.



The landscape of the North American Badlands today is bare and bleak, but during the Cretaceous it was covered with tropical swamps.

GIANTS OF THE PAST



Under the heat of the African sun, two male *Spinosaurus* take part in a colourful fight. Their technicoloured frills tell the females in the herd that it is time for mating and that the males are prepared to fight for leadership of the herd. One dinosaur has a rip in its sail from a previous fight; now it has a gash in its belly too. But it still manages to sink its teeth into the neck of the other *Spinosaurus* – and win the fight.

SPINOSAURUS

3-D Gallery 38

PARASAUROLOPHUS

- A crested hadrosaur
- Lived about 80 – 66 million years ago in North America
- Measured 10m long
- Ate plants and fruit

Noses and smelling

A good sense of smell was extremely important to animals that lived in the dangerous Age of the Dinosaurs.

Dinosaurs used their noses to sense a dangerous predator and to sniff out a tasty meal. By studying moulds of dinosaurs' brains scientists have discovered that the part of the brain that dealt with smell was quite large. This means that most dinosaurs had a good sense of smell.

IMPORTANCE OF SMELL

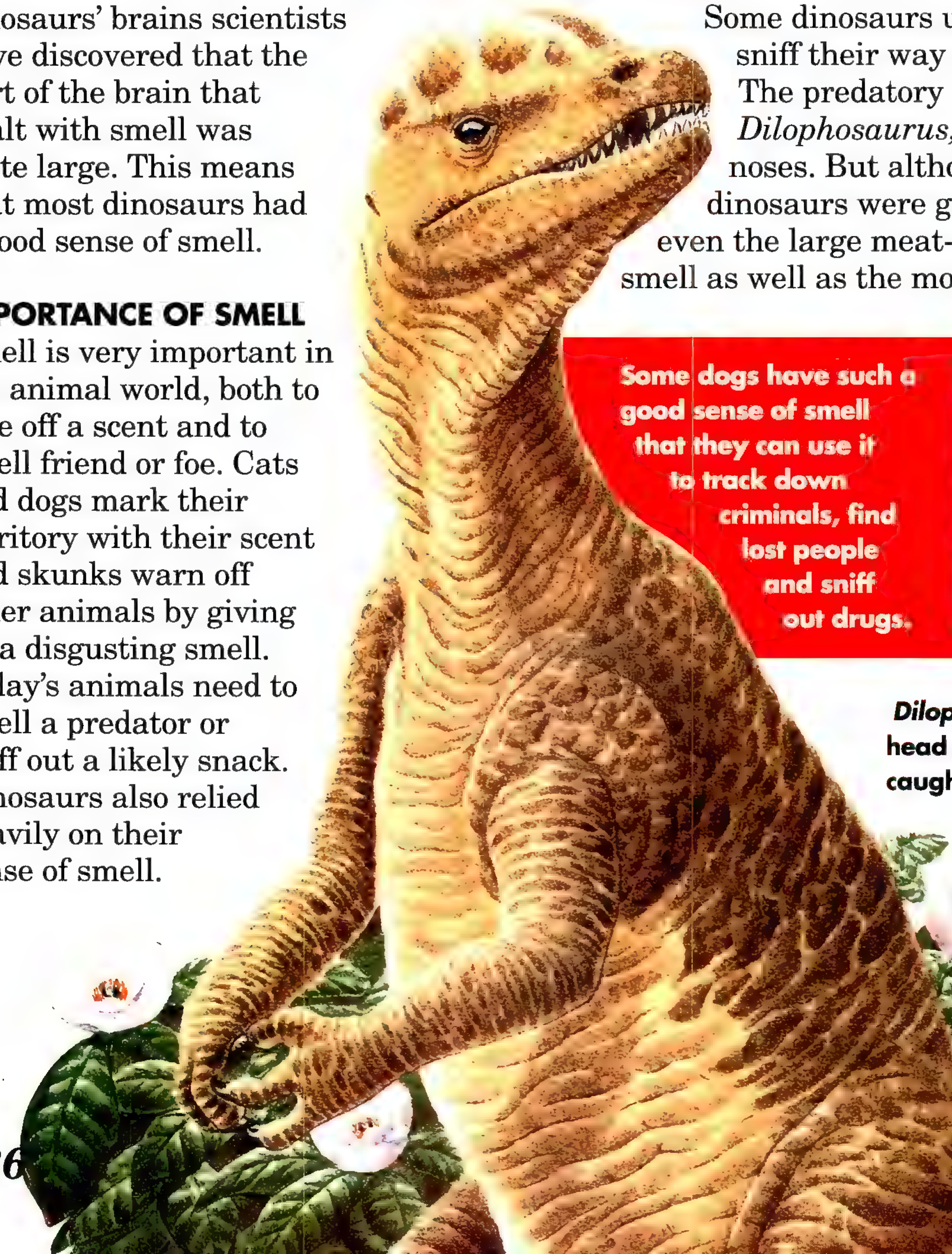
Smell is very important in the animal world, both to give off a scent and to smell friend or foe. Cats and dogs mark their territory with their scent and skunks warn off other animals by giving off a disgusting smell. Today's animals need to smell a predator or sniff out a likely snack. Dinosaurs also relied heavily on their sense of smell.

SCENT ON THE WIND

Like modern animals, dinosaurs used their noses to smell danger. Hadrosaurs could probably smell predators, just as modern deer can. It is almost impossible to creep up on a herd of deer. If the wind is in the right direction they smell danger and run.

HUNTING BY SMELL

Some dinosaurs used their noses to sniff their way to their next meal. The predatory dinosaurs, such as *Dilophosaurus,* hunted with their noses. But although most dinosaurs were good at smelling, even the large meat-eaters could not smell as well as the modern dog.



Some dogs have such a good sense of smell that they can use it to track down criminals, find lost people and sniff out drugs.

***Dilophosaurus* (left) raises its head and sniffs the air. It has caught a whiff of a scent and is working out what and where it is.**

A BREATH OF FRESH AIR

Brachiosaurus had very large nostrils. Instead of being at the end of its snout, they were on its forehead. Experts are not sure why the nostrils were so high up, but some suspect that a high nose allowed this massive dinosaur to eat plants in water and breathe at the same time.

TOUGH NOSES

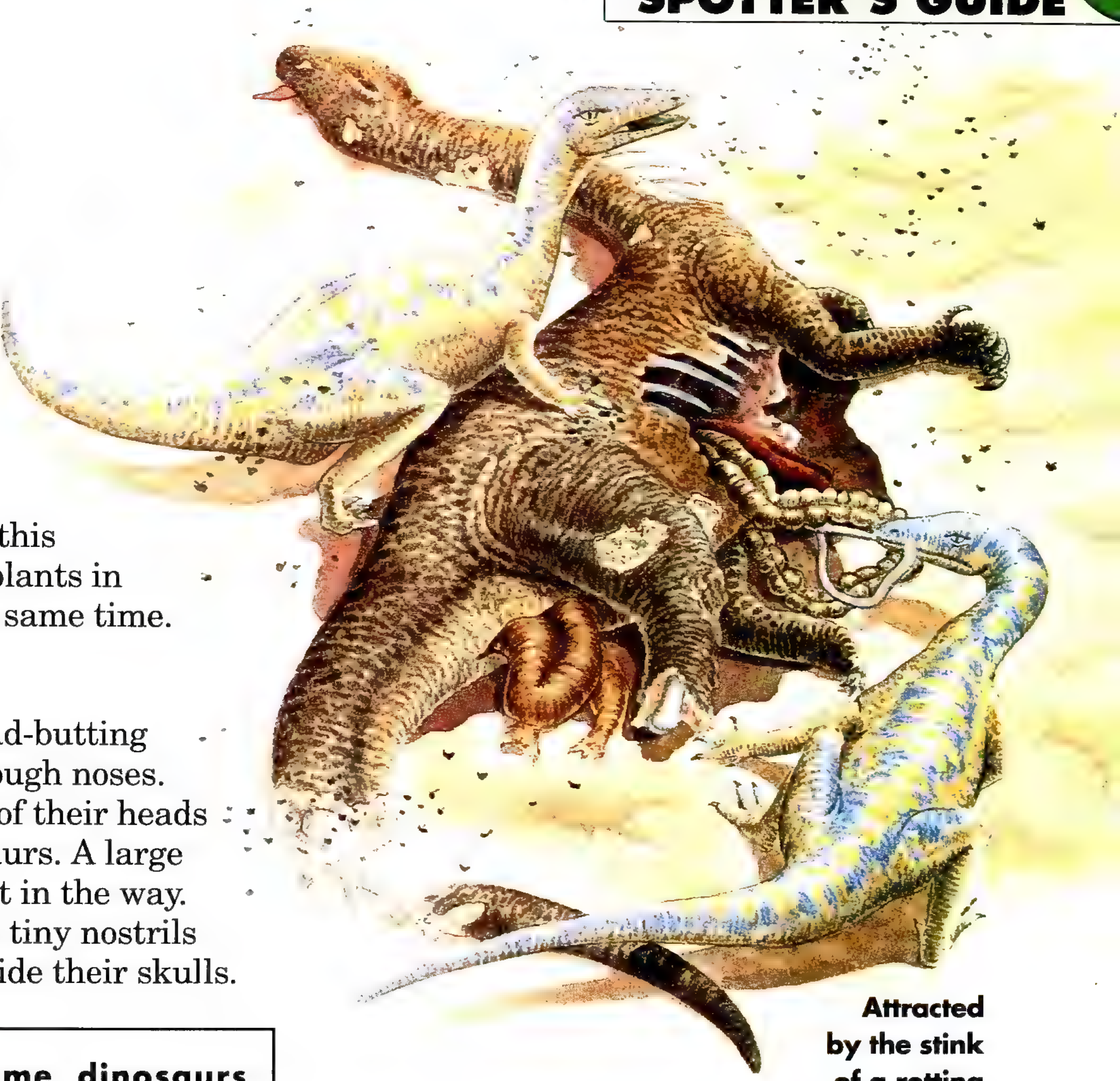
Stegoceras, and other head-butting dinosaurs, needed very tough noses. They used the front part of their heads to crash into other dinosaurs. A large snout would only have got in the way. Instead head-butters had tiny nostrils and small airways inside their skulls.

Is it true that some dinosaurs could never have smelt the scent of flowers?

Yes. Flowers did not exist in the Triassic and Jurassic Periods. All the dinosaurs that lived then would not have smelt the sweet scent of plants in bloom! Flowers evolved in the Cretaceous, so only dinosaurs that lived at the end of the Age of the Dinosaurs would have smelt them.

BLOWING THEIR NOSES

Some dinosaurs used their noses to make noises. Duckbilled dinosaurs, like *Anatotitan*, may have inflated a bag of skin above their noses when they wanted to hoot at another dinosaur. The male elephant seal does a similar thing with its huge inflatable nose.



Attracted by the stink of a rotting carcass, two *Coelophysis* have found a real feast.

LUMPY NOSES

Some dinosaurs had lumps and bumps on their noses. *Oviraptor* skulls have been found with lumps on the snout. Scientists think that these dinosaurs may have been the male of the species. Other dinosaurs, like the carnivore *Ceratosaurus*, had horns on the end of their noses.

A male elephant seal (left) blows up his nose and bellows to scare other males away from his females.

A dinosaur of her very own

When Leaellyn Rich (left) was only two, she asked her parents for her own dinosaur. A few years later her wish came true.

By the time Leaellyn was nine, she had helped her parents to discover a new dinosaur. It was named *Leaellynasaura* (lee-ellen-a-saur-a). The name means Leaellyn's dinosaur.

A LIKELY SPOT

The story begins at Dinosaur Cove in Australia in 1980 when Leaellyn was a baby. In that year, her parents, Tom Rich and Patricia Vickers-Rich, the Australian palaeontologists, discovered four small pieces of ancient fossilized bone, each about the size of an adult's thumbnail. They were in the rocks of Dinosaur Cove. But it took seven more years to find a new dinosaur at the cove.

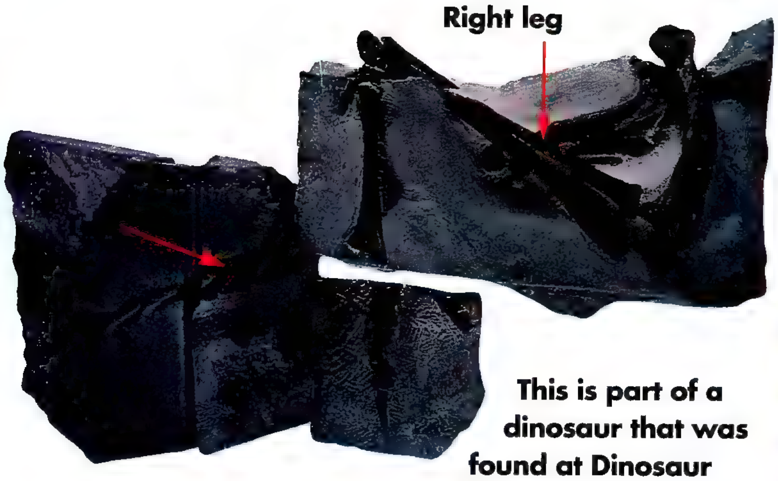
A PROMISE

From the age of two, Leaellyn went on dinosaur digs with her parents. She understood that they were hunting for dinosaurs and so she asked her parents if she could have a pet dinosaur of her own. Her parents explained that this was impossible, but they promised that if they ever found a new type of dinosaur, it would be named after her.

PLANNING EXPEDITIONS

Leaellyn's parents realised that if they were to find any more evidence of dinosaurs, they needed help because digging in the rocks at Dinosaur Cove would be difficult. When Leaellyn was six years old, they organised the first big expedition to Dinosaur Cove. They gathered 65 keen volunteers and armed themselves with mining machinery, explosives, fuel and food. The aim of the expedition was to work out clever ways to get at the fossils and to see if there really were dinosaurs at Dinosaur Cove.

Leaellyn (below) with her parents Tom Rich and Patricia Vickers-Rich.



This is part of a dinosaur that was found at Dinosaur Cove. It is similar to *Leaellynasaura*, but none of its teeth was found, so it cannot be identified.

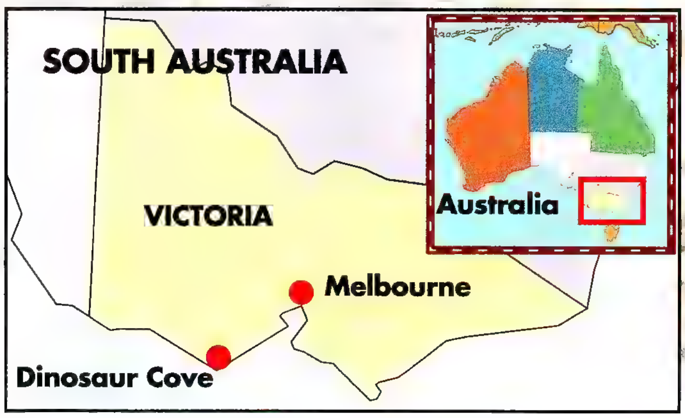
A RAY OF HOPE

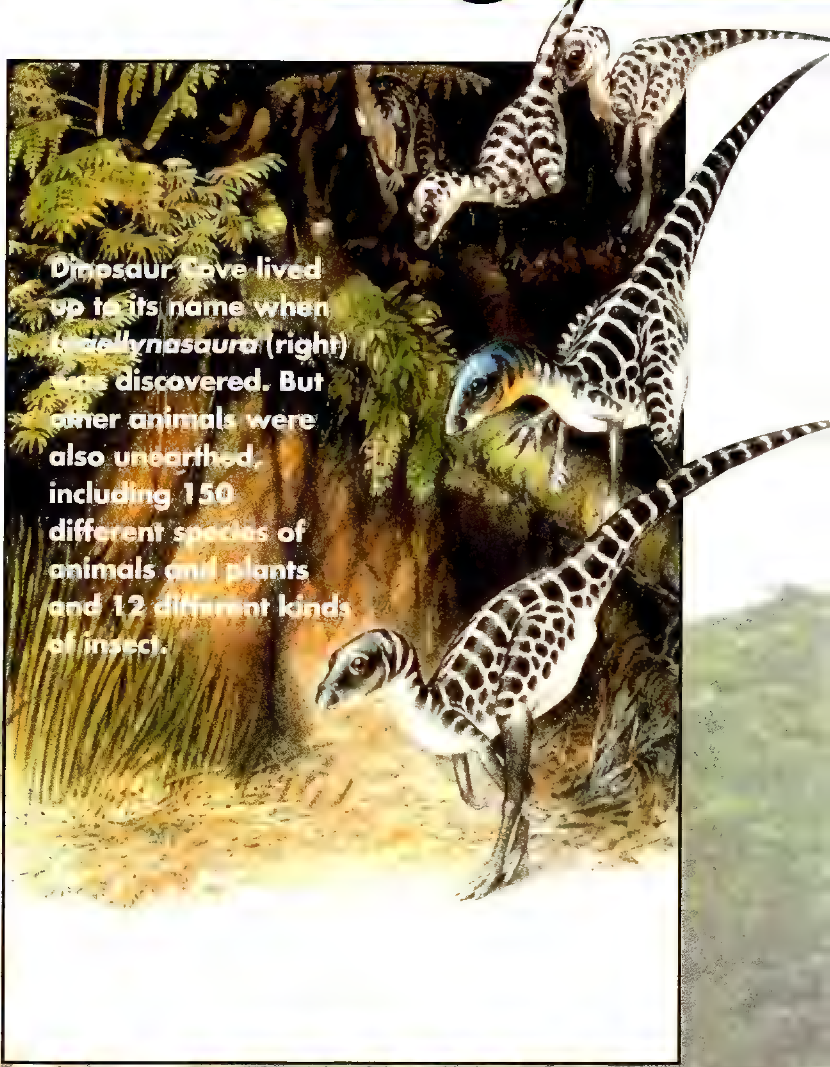
After 16 days' hard work in an area the size of two telephone boxes, the limb bones and a tooth of a dinosaur were found. Although they did not belong to a new dinosaur, this small find raised everyone's hopes that a new species of dinosaur would be found.

A WALK ON THE BEACH

At about the same time as this discovery, Leaellyn and her mother found a promising new site. They were walking along the beach and cleverly spotted a likely place to dig. But that was only the beginning. After three more years of hard work, blasting, chipping, drilling, and a bit of luck, they finally discovered a new dinosaur. As her parents had promised, the dinosaur was eventually named after Leaellyn.

Fossil hunters have found more than one dinosaur on the rocky coast of southern Australia.





Dinosaur Cove lived up to its name when *Leaellynasaura* (right) was discovered. But other animals were also unearthed, including 150 different species of animals and plants and 12 different kinds of insect.

LEAELLYN'S DINOSAUR

Leaellynasaura was one of the smallest known dinosaurs. It lived at a time when Australia and Antarctica were joined together. Despite being so close to the South Pole, the climate was probably cool, but not freezing. *Leaellynasaura* was an intelligent, large-eyed dinosaur, which wandered through the forests foraging for leaves. During the dark winter evenings it used its very large eyes to spot food.

LEAELLYNASAURA CHECK LIST

- **About 60cm long**
- **Ate plants**
- **Lived in Early Cretaceous Australia**

The amazing adventures

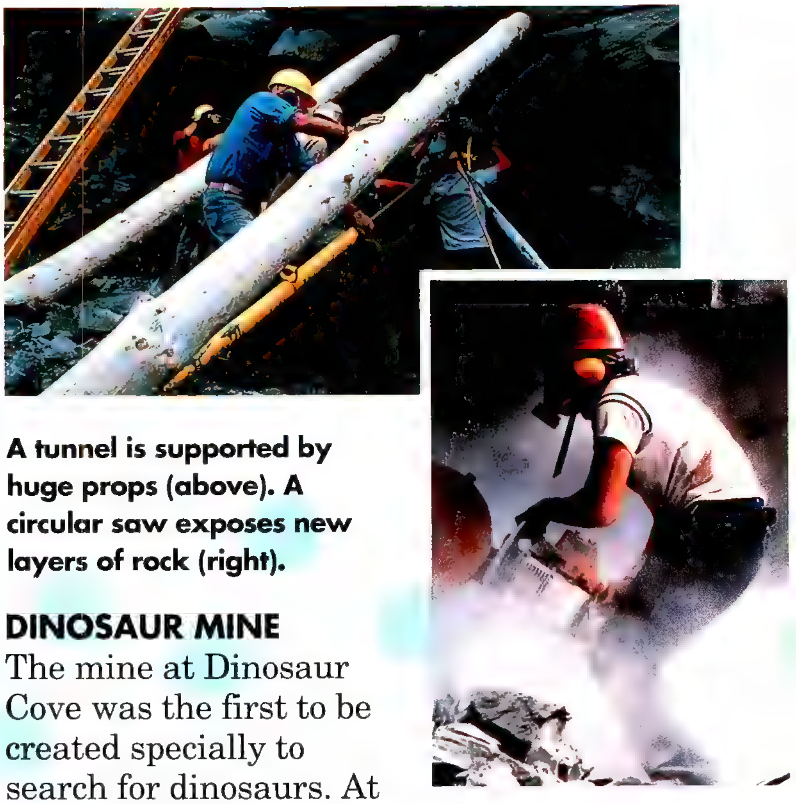
To bring *Leaellynasaura* into the daylight, the diggers worked long, dark hours, excavating cliffs close to rough seas using dangerous explosives.

When the digging first started at Dinosaur Cove, workers picked away at the rock with small hand tools. Lots of volunteers came to help and soon all the fossil-carrying rock that could be reached had been excavated. But the helpers had not been able to find anything that was really important. Better equipment was needed.

ROCK SOLID

Leaellyn's parents, who organised the dig, soon realised that the workers would have to tunnel into the rock. But the sandstone rock around Dinosaur Cove is as solid as hardened cement. They got help from mining companies, which lent equipment, and learned mining skills. Luckily many friends from the Museum of Victoria, Melbourne, came to help.

Lesley Kool, the helper who extracted *Leaellynasaura* from the rock, wraps fossils in paper.



A tunnel is supported by huge props (above). A circular saw exposes new layers of rock (right).

DINOSAUR MINE

The mine at Dinosaur Cove was the first to be created specially to search for dinosaurs. At the end of the expedition, after years of hard work, 300 tonnes of rock had been removed and 60m of tunnels had been dug. To do this the dinosaur miners used rock saws to break into the cliff face, rock drills to make holes in the stone and jackhammers driven by compressed air to break up slabs of rock.

THE 'FLYING FOX'

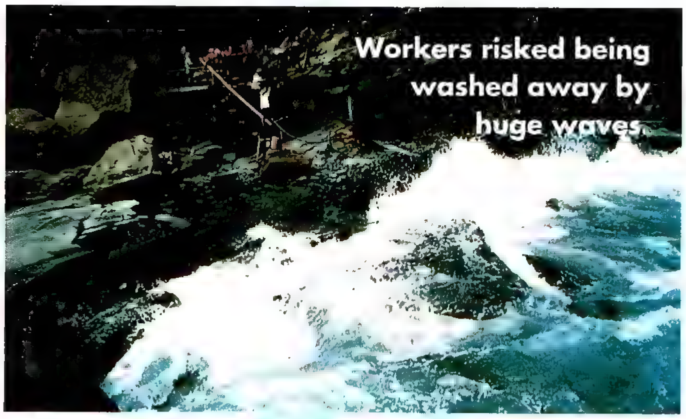
It was a long way up to the top of the cliffs. Climbing up and down with equipment, food and rocks was exhausting, so a large basket, which could be hoisted up, was attached to a cable. Like a mini cable car this lift, which was named the 'flying fox', could carry 300kg of equipment up to the clifftops.

The 'flying fox' is packed full of equipment and hoisted up the cliff.

at Dinosaur Cove

THE DANGERS OF THE SEA

One night a huge wave flooded the area where the digging was taking place. Heavy mining equipment was washed away, to be found later washed up in rock pools. The sea wasn't the only danger. In 1990, a 20 tonne boulder crashed down on to the flat rocks near the shore. Luckily no one was hurt.



Workers risked being washed away by huge waves.

FRIENDLY HELP

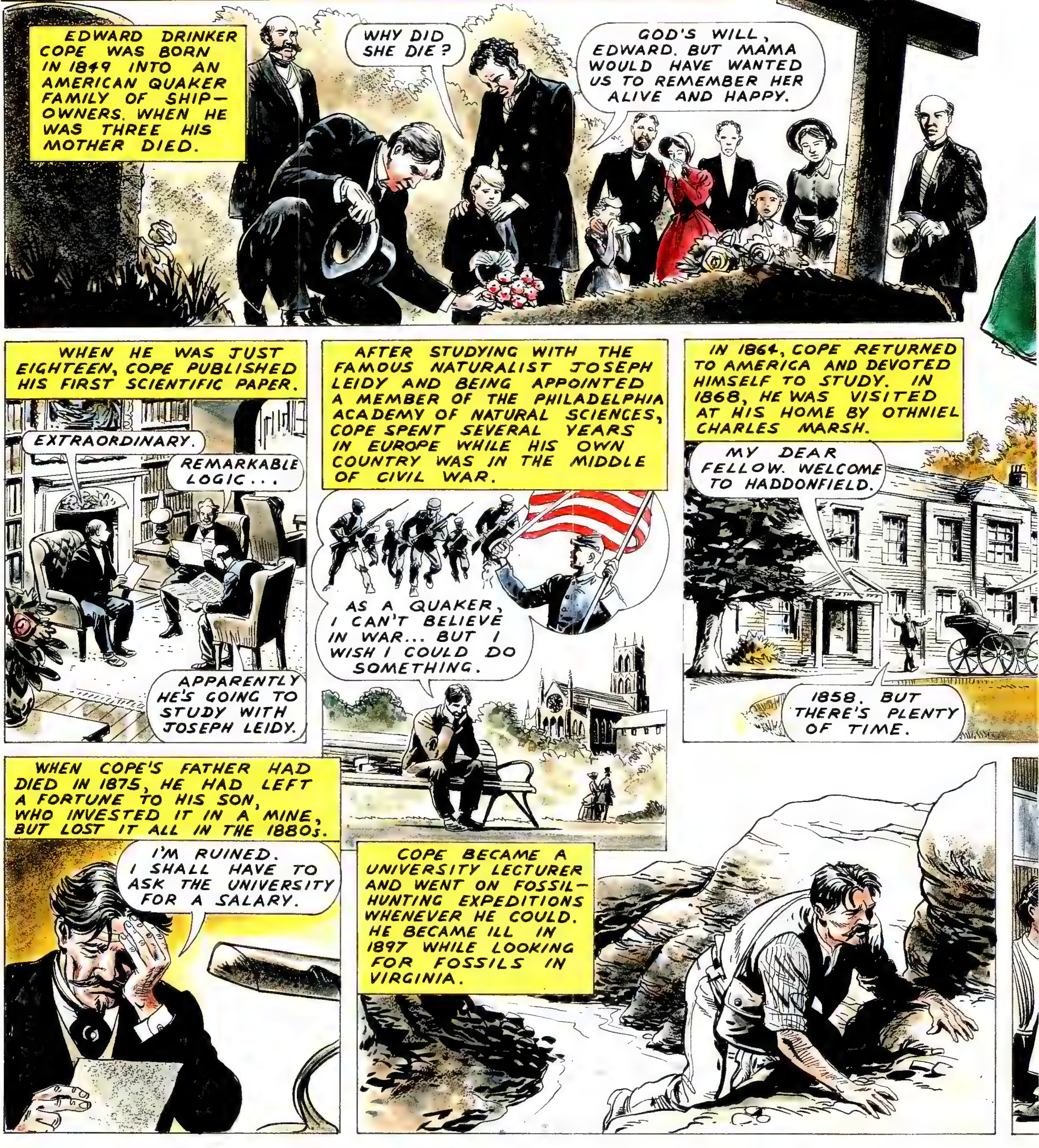
Most of the helpers had never been in a mine before, but they were taught by professional miners and learned quickly. To thank their friends who had helped at the digs, Tom and Pat Rich gave *Leaellynasaura* a second name: *amicagraphica*. *Amica* is Latin for 'friend'. Without their hard work *Leaellynasaura* may have remained in the tough sandstone for another 105 million years!

Is it true that some other children have had dinosaurs named after them?

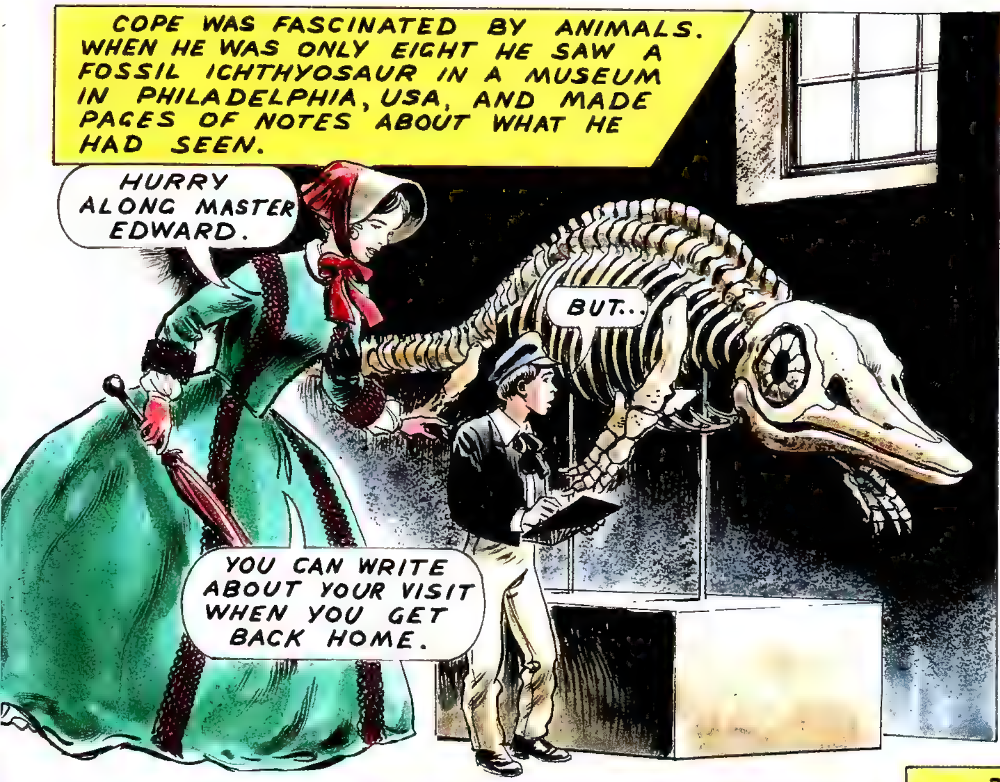
Yes. Timothy Rich is Leaellyn's younger brother. A new ornithomimosaur (a bird mimic dinosaur) has been found which will be named after him. His dinosaur will be called *Timimus*. Like other bird mimic dinosaurs, for example *Avimimus* and *Gallimimus*, its name must end in 'mimus', It was toothless, fleet-footed meat-eater. It is one of the earliest bird mimic dinosaurs and one of only two ever found in the southern hemisphere so far.

Two volunteers take a close look at one of the fossils found at Dinosaur Cove (above). Helpers sort through the rocks that have been blasted from the cliff face, looking for fossils (below).

A LIFETIME'S WORK


EDWARD DRINKER COPE WAS BORN IN 1849 INTO AN AMERICAN QUAKER FAMILY OF SHIP-OWNERS. WHEN HE WAS THREE HIS MOTHER DIED.
WHY DID SHE DIE?
GOD'S WILL, EDWARD. BUT MAMA WOULD HAVE WANTED US TO REMEMBER HER ALIVE AND HAPPY.
WHEN HE WAS JUST EIGHTEEN, COPE PUBLISHED HIS FIRST SCIENTIFIC PAPER.
EXTRAORDINARY.
REMARKABLE LOGIC...
APPARENTLY HE'S GOING TO STUDY WITH JOSEPH LEIDY.
AFTER STUDYING WITH THE FAMOUS NATURALIST JOSEPH LEIDY AND BEING APPOINTED A MEMBER OF THE PHILADELPHIA ACADEMY OF NATURAL SCIENCES, COPE SPENT SEVERAL YEARS IN EUROPE WHILE HIS OWN COUNTRY WAS IN THE MIDDLE OF CIVIL WAR.
AS A QUAKER, I CAN'T BELIEVE IN WAR... BUT I WISH I COULD DO SOMETHING.
IN 1864, COPE RETURNED TO AMERICA AND DEVOTED HIMSELF TO STUDY. IN 1868, HE WAS VISITED AT HIS HOME BY OTHNIEL CHARLES MARSH.
MY DEAR FELLOW. WELCOME TO HADDONFIELD.
1858. BUT THERE'S PLENTY OF TIME.
WHEN COPE'S FATHER HAD DIED IN 1875, HE HAD LEFT A FORTUNE TO HIS SON, WHO INVESTED IT IN A MINE, BUT LOST IT ALL IN THE 1880s.
I'M RUINED. I SHALL HAVE TO ASK THE UNIVERSITY FOR A SALARY.
COPE BECAME A UNIVERSITY LECTURER AND WENT ON FOSSIL-HUNTING EXPEDITIONS WHENEVER HE COULD. HE BECAME ILL IN 1897 WHILE LOOKING FOR FOSSILS IN VIRGINIA.

COPE WAS FASCINATED BY ANIMALS. WHEN HE WAS ONLY EIGHT HE SAW A FOSSIL ICHTHYOSAUR IN A MUSEUM IN PHILADELPHIA, USA, AND MADE PAGES OF NOTES ABOUT WHAT HE HAD SEEN.


HURRY ALONG MASTER EDWARD.
BUT..
YOU CAN WRITE ABOUT YOUR VISIT WHEN YOU GET BACK HOME.

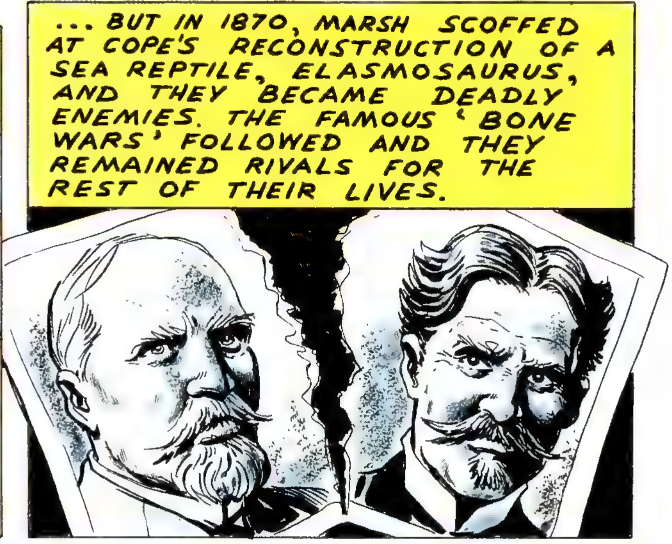
COPE'S FATHER TRIED TO INTEREST HIM IN FARMING, BUT EDWARD HAD OTHER THINGS ON HIS MIND.

THAT IS THE LATEST SEED DRILL. IT CAN DO THE WORK OF TEN MEN...
BORING! I WANT TO GO AND LOOK AT THE BIRDS AND ANIMALS, NOT LISTEN TO THIS.

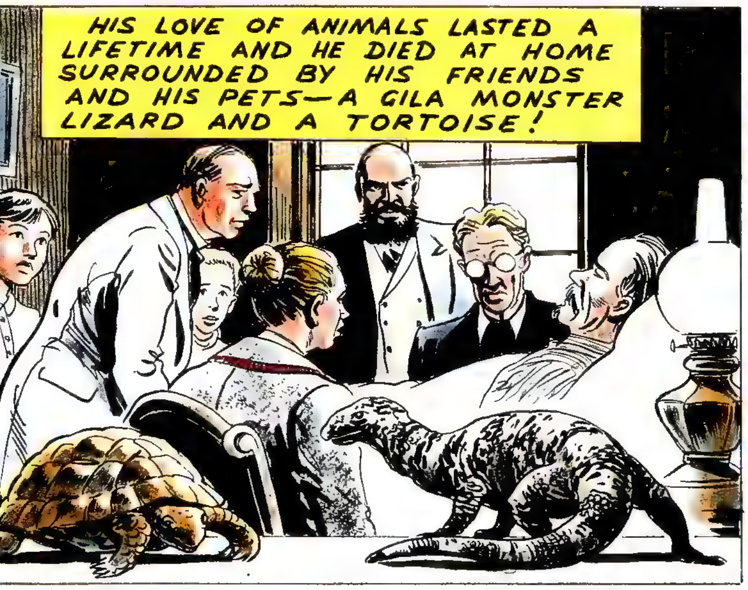
A PLEASURE TO BE HERE, SIR. NOW I WANT TO SEE FOR MYSELF WHERE THAT HADROSAUR WAS EXCAVATED IN... ER... WHEN WAS IT?

THE TWO MEN SPENT THE WEEKEND LOOKING FOR FOSSILS IN THE MARL PITS OF NEW JERSEY AND BECAME FIRM FRIENDS...

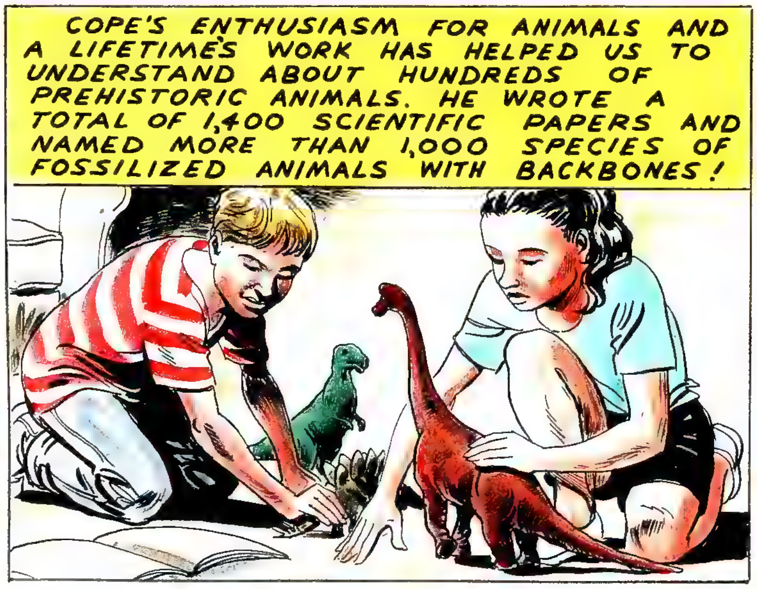
... BUT IN 1870, MARSH SCOFFED AT COPE'S RECONSTRUCTION OF A SEA REPTILE, ELASMOSAURUS, AND THEY BECAME DEADLY ENEMIES. THE FAMOUS 'BONE WARS' FOLLOWED AND THEY REMAINED RIVALS FOR THE REST OF THEIR LIVES.



HIS LOVE OF ANIMALS LASTED A LIFETIME AND HE DIED AT HOME SURROUNDED BY HIS FRIENDS AND HIS PETS—A GILA MONSTER LIZARD AND A TORTOISE!



COPE'S ENTHUSIASM FOR ANIMALS AND A LIFETIME'S WORK HAS HELPED US TO UNDERSTAND ABOUT HUNDREDS OF PREHISTORIC ANIMALS. HE WROTE A TOTAL OF 1,400 SCIENTIFIC PAPERS AND NAMED MORE THAN 1,000 SPECIES OF FOSSILIZED ANIMALS WITH BACKBONES!



Improve and test your knowledge with...

DINO Fact File

Climb down *Diplodocus*' neck answering the questions as you go.

Flexible jaws

T rex was the largest meat-eating land animal that has ever existed. This dinosaur had special loose-fitting bones in its jaw, which could change position slightly to allow T rex to swallow large chunks of meat.

3 Where did *Rhoetosaurus* live?

- a) Australia
- b) New Zealand
- c) Austria

4 *Mussaurus* means:

- a) Muskrat reptile
- b) Moose reptile
- c) Mouse reptile

5 Where did *Maiasaura* have a bony knob?

- a) on its knees
- b) on its tail
- c) above its eyes

6 *Majungatholus* was discovered on which island?

- a) Corsica
- b) Sicily
- c) Madagascar

7 How long was *Parasaurolophus*?

- a) 10m
- b) 1.5m
- c) 30m

8 Why did dinosaurs need a good sense of smell?

- a) to smell flowers
- b) to find food and sense danger
- c) to sense humans

9 During the Jurassic, Europe was covered with:

- a) deserts
- b) lagoons and swamps
- c) grass

10 Which dinosaur was named after a little girl?

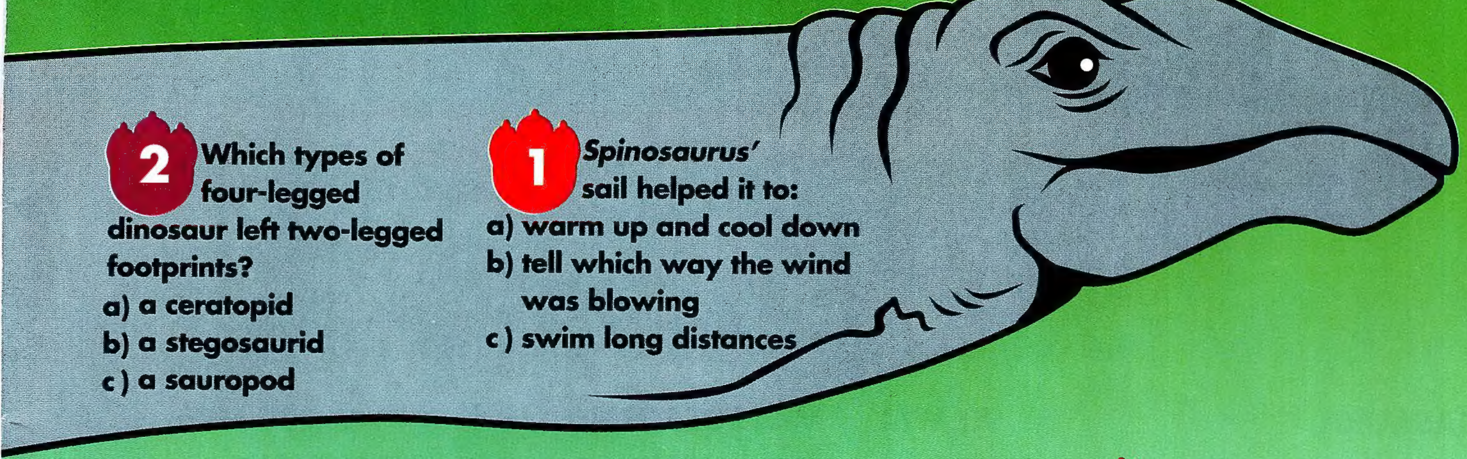
- a) *Leaellynasaura*
- b) *Avaceratops*
- c) *Damalasaurus*

Chance discovery

While touring on his Harley Davidson motorbike, a young man called Charles Sternberg decided to take a short break in Glen Rose, USA. Stopping at a tourist shop, he noticed a huge slab of rock for sale with some very interesting imprints in it. These marks turned out to be a dinosaur's footprint. Sternberg followed this lead, and discovered nearby one of the most famous sauropod trackways in the world.

The survivors

Dinosaurs all over the world died out suddenly 66 million years ago. Other prehistoric animals, such as ichthyosaurs, plesiosaurs, mosasaurs and pterosaurs also disappeared around this time. But crocodiles, lizards, mammals and birds survived, and are still around today.



2 Which types of four-legged dinosaur left two-legged footprints?

a) a ceratopid
b) a stegosaurid
c) a sauropod

1 *Spinosaurus'* sail helped it to:

a) warm up and cool down
b) tell which way the wind was blowing
c) swim long distances

Dinosaur timetable

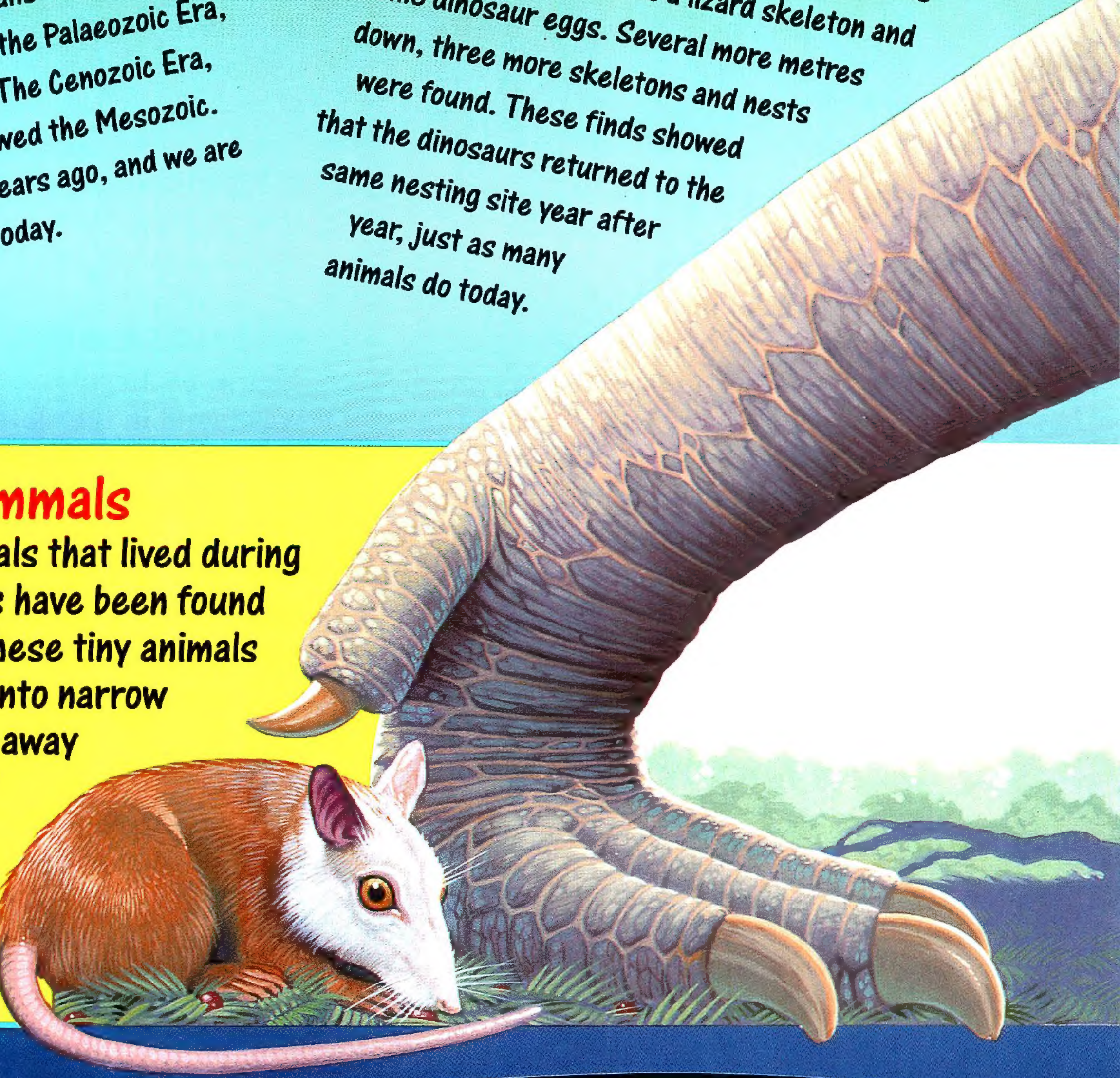
Dinosaurs lived during the Triassic, Jurassic and Cretaceous Periods. These three periods together make up a longer span of time known as the Mesozoic Era, which means 'middle life'. Before the Mesozoic Era was the Palaeozoic Era, which means 'ancient life'. The Cenozoic Era, meaning 'recent life', followed the Mesozoic. This era began 66 million years ago, and we are living in it today.

Home to nest

In Egg Mountain, Montana, three different layers of dinosaur remains were found in the same area. On the first level one hypsilophodontid skeleton and four nests were uncovered. A few metres below them were another six dinosaur skeletons and four nests, as well as a lizard skeleton and some dinosaur eggs. Several more metres down, three more skeletons and nests were found. These finds showed that the dinosaurs returned to the same nesting site year after year, just as many animals do today.

Mini mammals

Many of the small mammals that lived during the time of the dinosaurs have been found beautifully preserved. These tiny animals often died after falling into narrow crevices or cracks. Here, away from the sharp teeth of meat-eating predatory dinosaurs, their bones turned slowly to perfect fossils.



Answers to the questions on inside back cover

MAIASAURA **90 MYA**

Maiasaura (my-a-saw-ra) means 'good mother lizard'. In 1979 the remains of some baby dinosaurs were found in their nests in Montana, USA. Scientists think that these hatchlings were protected and fed by their parents until they were old enough to leave the nest. *Maiasaura* probably lived in herds and ate plants. It was as long as a double-decker bus and had a bony knob just above its eyes.

MAJUNGATHOLUS **75 MYA**

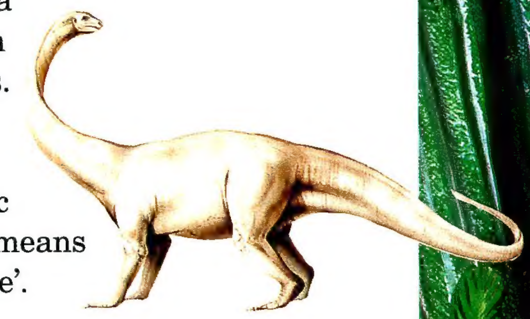
This dome-headed pachycephalosaur was found on the island of Madagascar, off the south-eastern coast of Africa. *Majungatholus* (ma-yung-a-thol-us) means 'dome from Majunga', after the place where it was discovered. It was the first high-domed dinosaur to be found in the southern hemisphere. *Majungatholus* was only about 1.2m long, walked on two legs and ate plants.

MAMENCHISAURUS **145 MYA**

Mamenchisaurus (ma-mench-ih-saw-rus) had the longest neck of any land animal that ever lived. It was 10m long, almost half the length of its entire body. Rods of bone gave the neck extra strength. *Mamenchisaurus* lived in the Late Jurassic in China. It walked on four legs and ate plants. *Mamenchisaurus* was named after Mamenchi, the place where it was found.

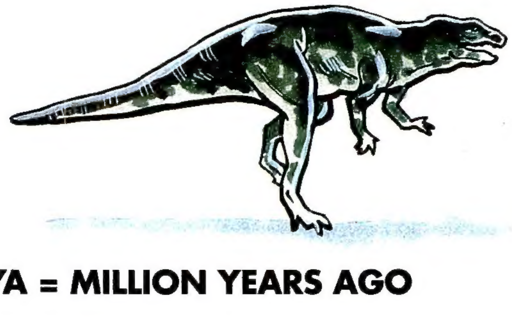
MASSOSPONDYLUS **200 MYA**

Small pebbles were found by the remains of this plant-eater. Experts think that *Massospondylus* (mass-oh-spond-ih-lus) swallowed them to help digest the plants and leaves it ate. *Massospondylus* was longer than a rhinoceros. Standing on its back legs, it could reach the tops of tall trees. Each thumb ended in a long, curved claw that could be used as a defensive weapon against predators. *Massospondylus* lived in Africa in the Early Jurassic Period. Its name means 'massive vertebrae'.



MEGALOSAURUS **145 MYA**

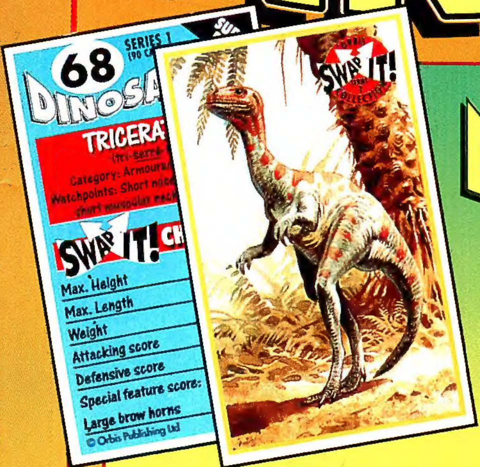
Fearsome *Megalosaurus* (meg-a-low-saw-rus) was found in the slate mines of a village in Oxfordshire, England, in 1818. It was as long as a bus and had sharp, deadly teeth. *Megalosaurus* was the first two-legged meat-eater to be named. *Megalosaurus* means 'great reptile'. The name has also been given to many large theropods that cannot be properly identified, which can cause confusion.



MYA = MILLION YEARS AGO

COMING IN PART 30 OF

DINOSAURS!



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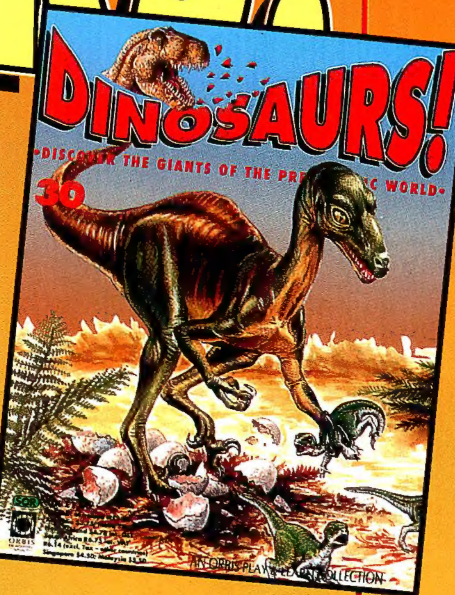
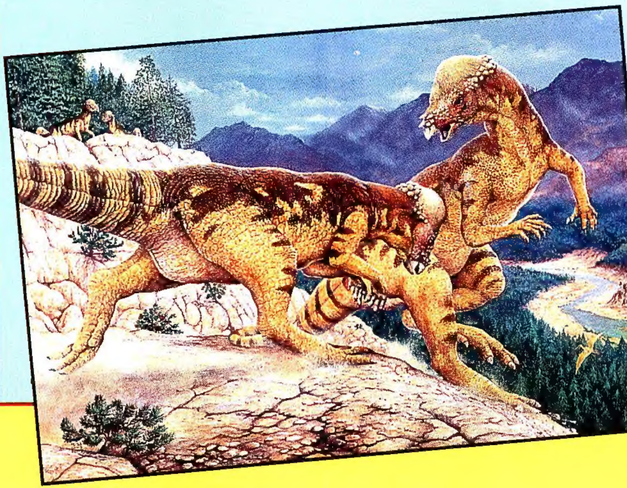

DINOSAURS!
DISCOVER THE GIANTS OF THE PREHISTORIC WORLD
30
ORBIS
AN ORBIS PLAY & LEARN COLLECTION

Meet ferocious meat-eater *Nanotyrannus*, that fed on young dinosaurs. Find out about the dinosaurs that wandered through the shadowy prehistoric woods in DINOSAUR WORLD.

THE DINOSAURS! POSTER COLLECTION

Have you ever wanted to fill your room with dinosaurs? Now you have your chance – with the *Dinosaurs!* POSTER COLLECTION. Each poster is a 820 x 570mm (nearly eight times the size of this page) and features a superb dinosaur artwork. You'll find facts and figures about the dinosaur on the back – PLUS a look at some other prehistoric animals. The ninth poster is *Pachycephalosaurus*. On sale at newsagents.



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Artwork: Black Hat 674 T, 695, 696 TL, BR; Barry Croucher/Wildlife Art Agency 673, 675, 686, 687; Mike Dorey 692/3; Riz Hajdul/(WLAA) 678/9; Grisewood and Dempsey/Kevin Maddison 674 B, 676 T; Grisewood and Dempsey/Jim Channell 696 TR; Peter Menzel 688; Pinsharpe 3D Graphics 684/5; Clive Pritchard/(WLAA) 680/1; Graham Rosewarne 676 B, 677 B; Peter Schouten 689 TR; Peter D Scot/(WLAA) 682/3. 3-D Gallery: model supplied by the Natural History Museum, London.

ANSWERS TO DINO FACT FILE QUESTIONS: 1.a 2.c 3.a 4.c 5.c 6.c 7.a 8.b 9.b 10.a

Dr. David Norman of Cambridge University answers your dinosaur questions

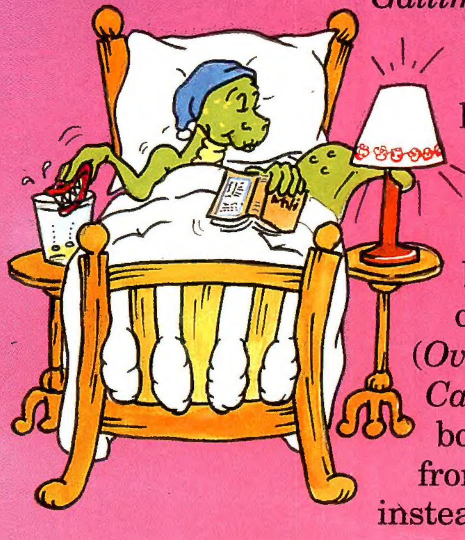
ASK THE EXPERT

Is a dragon a kind of dinosaur?

No, a dragon is not a kind of dinosaur. In China it has been popular for centuries to grind up dragons' teeth into a powder, which is supposed to cure all sorts of illnesses. In some instances, these dragons' teeth have been proved to come from dinosaurs, so there is a sort of link between dragons and dinosaurs. However, dragons are mythical beasts (they were not real); dinosaurs were very real, and we have their fossil remains to prove it.

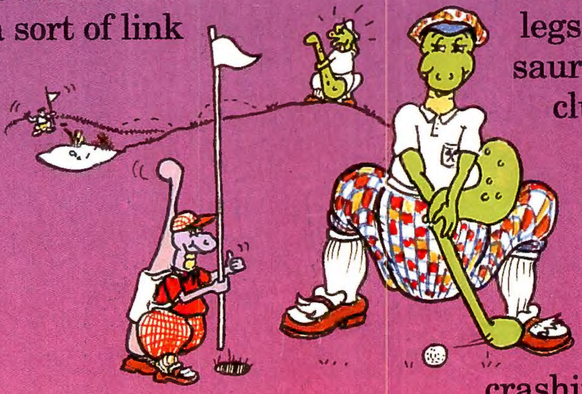
Did any dinosaurs have no teeth at all?

Several dinosaurs had no teeth. One of the best known groups is the ornithomimosaurs (*Struthiomimus, Ornithomimus* and *Gallimimus*), which are ostrich-like dinosaurs with long necks and legs, large eyes and toothless beaks. The rather bizarre-looking oviraptorosaurs (*Oviraptor* and *Caenagnathus*), had bony prongs at the front of their mouths instead of teeth.



Why did some dinosaurs have clubs on their tails?

Ankylosaurs and a few sauropods probably had tail clubs made of bone. The main predators of these dinosaurs were the very large carnivores. These large predators walked only on their hind legs. If an ankylosaur or a sauropod could swing its club at the leg of the predator it could knock it off balance. For the predator this could be fatal. Imagine two tonnes of tyrannosaur crashing to the ground! The chances of breaking a bone were very high, it probably could not get up again, and may have been pounced on by one of its own kind. So tail clubs were very good weapons of defence.



Did all dinosaur bones fossilize?

No they did not! Only a very small percentage of the dinosaurs living at any one time were preserved, and of these only a few were preserved very well. If an animal is buried soon after it dies and before it rots, it stands a good chance of fossilizing.

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